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AMBIENT AIR QUALITY STUDY AT E.B. EDDY PULP AND PAPER MILL ESPANOLA

AUGUST 1986

ARB-092-87-AQM

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Ministry of the Environment
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E. PICHÉ, Director
Air Resources Branch

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PREPARED FOR THE
NORTHEASTERN REGION
MINISTRY OF THE ENVIRONMENT

by

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1.0 SUMMARY

A mobile air monitoring unit (MAMU #2) from the Air Resources Branch performed an air quality survey in Espanola in mid-August 1986 in the vicinity of the E. B. Eddy pulp and paper mill.

Most of the monitoring was in the area of the aerated lagoon system recently installed for treatment of the mill's wastewater before discharging to the Spanish River. The wind directions existing during the survey period usually made it impossible to position the MAMU at accessible locations downwind of the mill itself.

During the only morning when an odorous fog was present in the residential area closest to the lagoon, the total reduced sulphur (TRS) level exceeded the Ontario provisional guideline of 27 parts per billion (ppb) as the fog was dissipating.

Air sampling around the lagoon area showed the settling basins to be the main source of TRS odours. The settling basin in use produced ambient air TRS levels in the range of 64 to 241 ppb (½-hour average). The aeration cells of the lagoon system then lowered the TRS levels to 8 ppb before the wastewater entered the quiescent zone for discharge to the river. The settling basin not in use produced the highest TRS levels in the lagoon area, namely 456 ppb (½-hour ave.). The spill basin showed a TRS level of 26 ppb (average).

Limited monitoring opportunities downwind of the mill produced a maximum ½-hour average concentration of 11 ppb TRS with occasional odours.

None of the monitored organic compounds exceeded their Ontario standards or guidelines during the survey period. Trichloromethane (chloroform) and 1 -isopropyl -4-methylbenzene were expected at this lagoon because of their prominence at other lagoon systems in Ontario; they were among the major compounds found here also.

2.0 INTRODUCTION

At the request of the Northeastern Region a mobile air monitoring unit (MAMU #2) from the Air Resources Branch performed an air quality study in Espanola in mid-August, 1986. The purpose of the study was to determine the effects on air quality of recently implemented pollution abatement measures at the E.B. Eddy pulp and paper mill. Mill modernization and a lagoon system are the main changes since the last ambient air study in 1978.

A major concern was the impact of the lagoon system used for treatment of the mill's liquid effluent before discharge to the Spanish River (Figure 1). Complaints from nearby residents had indicated an odour problem at the lagoon, so a large portion of the study was directed at determining which areas of the lagoon system were most responsible for the odour problem. Total reduced sulphur (TRS) and a large number of organic compounds were the most important contaminants measured in the lagoon area.

Measurements were also made downwind of the pulp and paper mill when weather conditions were appropriate and road access was available.

3.0 SURVEY TECHNIQUE

3.1 Residential Area

On the first two mornings (07:00 hrs) the monitoring crew patrolled the residential area east of the railway tracks around Second Avenue (Figure 1) in search of odourous conditions due to the nearby lagoon. While monitoring there on the second morning (August 13) a local resident approached the crew and noted that an odorous fog had been present around 06:00 to 06:30 that morning. On all subsequent days the area was patrolled before 06:00 but the foggy conditions were not encountered.

3.2 Within Lagoon Boundary

The lagoon system (Figure 2) consisted of seven distinct areas from a monitoring perspective. The seven distinct areas were: the inlet and outlet areas of the settling basin being used, the settling basin not in use, aeration cell #1, aeration cell #2, the quiescent zone (final stage before discharge to the river), and the spill basin. Since there are service roads around and between these areas the wind direction was not a limiting factor in effective monitoring.

The sampling system inlet on MAMU #2 is normally located above the roof level but for the lagoon study a 25 foot hose and attached funnel were coupled to the sample inlet. Sampling could then be done at ground level within a few feet of the area in question.

Most sampling periods were at least 40 minutes long to ensure that a representative half-hour average concentration would be determined and to allow a half-hour gas chromatograph (GC) sample to be collected and processed to an appropriate stage before moving the vehicle.

3.3 Overnight

The monitoring unit was parked each night at the electrical building on the lagoon property (Figure 2). This allowed the MAMU's electrical generators to be rested and also allowed total reduced sulphur and several other parameters to be monitored close to the lagoon overnight. The gas chromatograph was not operated because it required personnel to be present.

3.4 Pulp and Paper Mill

The wind direction was generally unsuitable for monitoring the mill since the visible plume was usually over the Spanish River on the east side of the mill, an

area with limited, if any, access. An attempt was made on two days, August 16 and 18, to monitor contaminants downwind of the mill during periods of suitable wind direction.

4.0 RESULTS AND DISCUSSION

The monitoring periods, locations and comments are listed in Table 1. A summary of the results is shown in Table 2.

4.1 Residential Area

a) Total Reduced Sulphur

The only monitoring period in the residential area was during the dissipation of the fog on August 13 (site #4) that was reportedly (through an observation from a resident) its worst two hours earlier. The maximum ½-hour average concentration of TRS was 37 ppb, which is slightly above the Ontario Provisional Guideline of 27 ppb. The winds were very light from the lagoon direction and there was a faint odour of TRS.

b) Organic Compounds

The gas chromatographic samples for this period consisted mostly of alkanes, which indicated gasoline generator emissions from MAMU #2 were a large influence during the nearly calm winds. The presence of chlorinated compounds, although in small quantities, was evidence of some influence by the lagoon.

4.2 Within Lagoon Boundary

a) Total Reduced Sulphur-

The results for the lagoon area measurements can be found in the general summary of results in Table 2, but the clearest understanding of the TRS results comes from Figure 2. The location numbers (map sites) are circled, the TRS concentrations (ppb, ½-hour ave.) are shown at each location, and the small arrows show the wind direction for each period.

The wastewater entry point to the lagoon system during this study was in settling basin #1 near location 8. TRS measurements at locations 3 and 8 showed 64, 127 and 135 ppb downwind of the entry point. The wastewater exit point from settling basin #1 is near location 6. The odour was stronger at that location and the TRS levels were significantly higher at 157 and 241 ppb.

The wastewater left the settling basin and entered aeration cell #1 and proceeded through aeration cell #2 to the quiescent zone before discharge to the river. The TRS levels showed a steady decrease roughly proportional to the distance travelled (by the wastewater) through the aeration area. The TRS levels dropped to 61 ppb, then to 23 ppb, then to 8 ppb before entering the quiescent zone. Two measurements near the quiescent zone outlet showed TRS levels of 20 and 21 ppb, a little higher than expected but perhaps influenced by the proximity of settling basin #1.

Settling basin #2 was not "on-line" during the study and its surface was approximately ten feet lower than the surface of settling basin #1. It is interesting, however, that two measurements downwind at locations 8 and 12 gave the highest TRS levels in the lagoon area, 456 ppb and 361 ppb. An upwind measurement at location 7 showed only 6 ppb.

The spill basin had a very low surface level and showed a TRS level of 26 ppb at location 13.

b) Organic Compounds

A brief summary of the results is listed in Table 2 for total hydrocarbons (THC), alkanes (ALK) and chlorinated alkanes (CL-ALK). The CL-ALK show a variation with location that is highly similar to the TRS variation, as might be expected; that is, a certain level at the settling basin inlet, a higher level at the settling basin outlet, and then a gradual decrease as the wastewater passes through the lagoon system toward the discharge point.

Samples which show alkanes to be a large fraction of the total hydrocarbons are more indicative of normal background measurements, where exhaust and evaporative emissions from vehicles are the usual major sources.

The off-line settling basin, the spill basin and an upwind location showed lower levels of THC and CL-ALK.

Consideration of the detailed gas chromatographic results for the 134 organic compounds contained in the instrument's library showed that none of the monitored compounds exceeded their Ontario standards or guidelines for ½-hour average concentrations at any time during the survey. A list of the 134 monitored organic compounds is contained in Table 3 along with the maximum and minimum

concentrations found and the number of samples (maximum of 20) where each compound was detected. A detailed list of the results for each monitoring site will be provided to the Northeastern Region staff and to E.B. Eddy personnel for further analysis.

The only compound concentrations worth noting are for trichloromethane (chloroform), 1,5 dichloropentane and 1-isopropyl-4-methylbenzene (p-cymene). They are compound #'s 37, 109 and 118 in Table 3. Trichloromethane and 1-isopropyl-4-methylbenzene were prominent at other lagoon systems in Ontario, hence they were expected at this lagoon. Their presence was confirmed by independent gas chromatographic/mass selective detector identification on some adsorbent cartridge samples collected at the lagoon and analyzed in the laboratory at Air Resources Branch. The identification of 1,5 dichloropentane is less certain, however, and there is a strong possibility that the compound was co-eluting from the GC column with an unknown impurity in the GC sample handling system. Subsequent efforts to clean the system seem to have been successful.

4.3 Overnight

For each of the six nights that MAMu #2 was parked at the lagoon the concentration of TRS was found to equal or exceed the Ontario Provisional Guideline of 27 ppb (½-hour average) for one or more periods. The maximum ½-hour average concentration for each overnight sampling interval is found in Table 2. Careful scrutiny of the entire set of results for each overnight period shows that the higher TRS levels usually occurred when winds were light (3 km/hr) from the direction of the two settling basins. The only other occurrence of significant TRS levels was accompanied by winds up to 13 km/hr from the direction of the settling basin.

4.4 Pulp and Paper Mill

a) Total Reduced Sulphur

On August 16 the mill plume was accessible only briefly along the Old Nairn Road about 1.3 km northeast of the mill. There was a faint TRS odour but only low levels (0 to 5 ppb) were detected.

On August 18 the wind was from the east-northeast at 4 to 8 km/hr and there was occasional TRS odour at monitoring sites 0.2 km and 1.0 km west of the mill. The maximum ½-hour average concentration was 11 ppb at the closest (Tudhope St.) site, where the highest 1-minute average concentration was 46 ppb.

b) Organic Compounds

Gas chromatographic analysis was done only at the Tudhope Street site on August 18. Two-thirds of the total organics (mass) detected were alkanes, which seemed appropriate for the main street location with frequent traffic.

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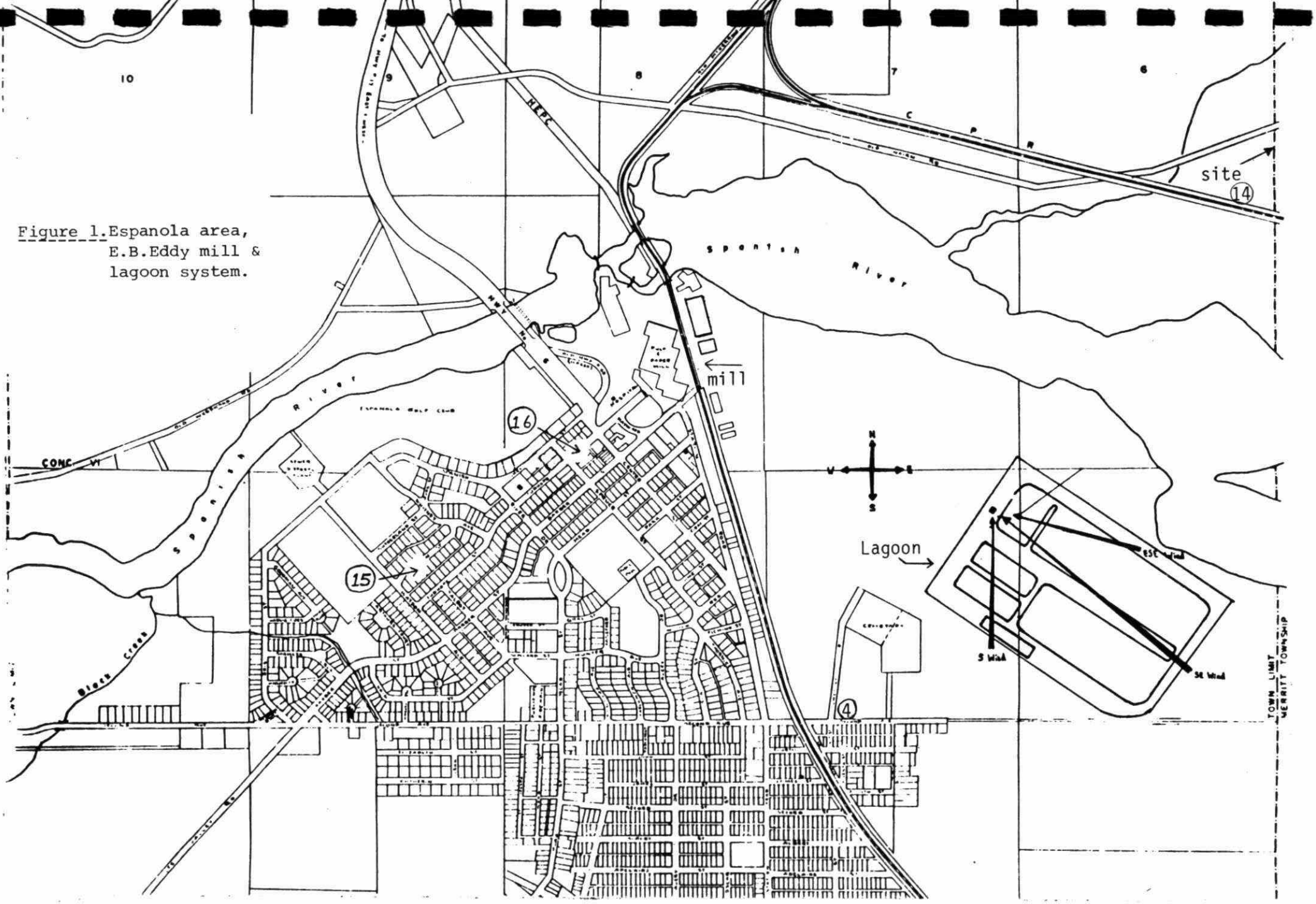

Figure 1. Espanola area, E.B.Eddy mill & lagoon system.

SECONDARY TREATMENT LAGOON SYSTEM

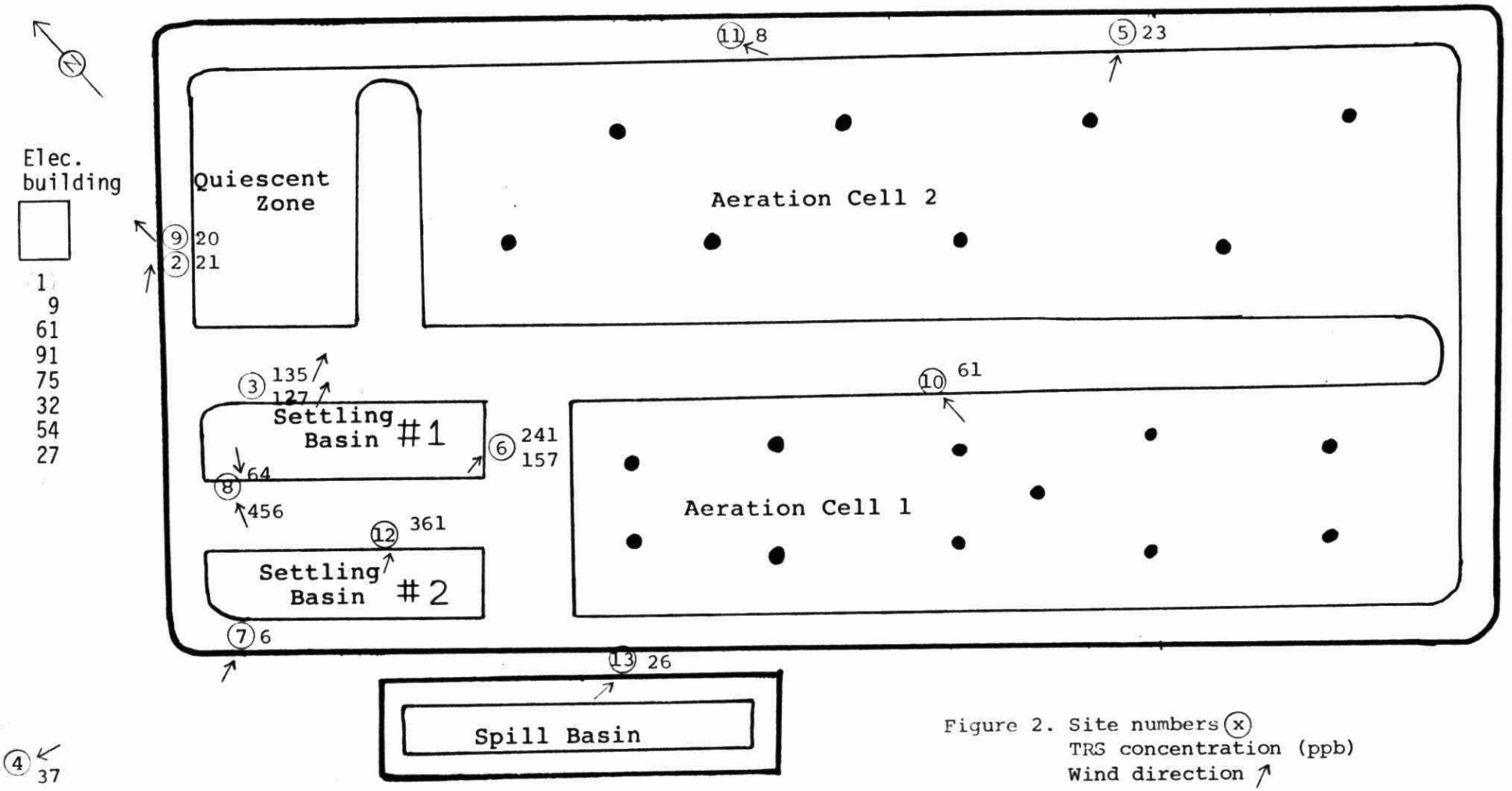

Figure 2. Site numbers (x)
TRS concentration (ppb)
Wind direction ↗

TABLE 1. Monitoring Periods and Locations

SITE*	LOCATION	TIME PERIOD	COMMENTS
1	Lagoon	12-Aug-86 13:24-14:44	Electrical building
2	Lagoon	12- Aug-86 15:10-15:43	At Lagoon outlet, but wind direction off by 20° to 70°; occas. odour from inlet.
3	Lagoon	12-Aug-86 16:53-19:10	Lagoon inlet, in-use settling basin (#1)
1	Lagoon	12-Aug-86 19:26-07:25	Overnight at elec. building
4	213 Second Street	13-Aug-86 08:02-09:51	Residential area; odorous fog dissipating; very light winds, steady 15-30 ppb TRS, odour
5	Lagoon	13-Aug-86 10:17-11:20	Aeration cell #2, north side.
6	Lagoon	13-Aug-86 11:32-13:34	In-use settling basin at exit point, strongest odours in Lagoon area.
3	Lagoon	13-Aug-86 13:47-14:55	In-use settling basin, 50 m E of inlet point on NE shore.
7	Lagoon	13-Aug-86 15:03-15:56	Upwind of Lagoon system, near not-used settling basin (#2)
1	Lagoon	13-Aug-86 16:34-05:48	Overnight
8	Lagoon	14-Aug-86 08:29-10:49	Settling basin #1 for first half of period; wind shift brings settling basin #2 for second half.
9	Lagoon	14-Aug-86	Lagoon outlet - Quiescent zone

*See Figures 1 and 2

TABLE 1. Monitoring Periods and Locations (Cont'd)

SITE*	LOCATION	TIME PERIOD	COMMENTS
10	Lagoon	14-Aug-86 12:29-13:42	Aeration Cell #1, north side.
11	Lagoon	14-Aug-86 13:55-14:36	Aeration Cell #2, north side.
1	Lagoon	14-Aug-86 14:59-08:40	Overnight, several TRS episodes.
6	Lagoon	15-Aug-86 10:24-11:12	Settling basin #1, at exit point.
12	Lagoon	15-Aug-86 11:27-12:13	Settling basin #2, mid-point on north side
13	Lagoon	15-Aug-86 12:44-13:25	Spill basin, north side.
1	Lagoon	15-Aug-86 14:03-09:17	Overnight.
14	Old Nairn Road	16-Aug-86 11:40-12:45	Old Nairn Road, approx. 1.3 ENE of mill.
1	Lagoon	16-Aug-86 13:14-10:23	Overnight.
1	Lagoon	17-Aug-86 12:00-07:14	Overnight.
15	#336 Southon Drive	18-Aug-86 08:56-09:31	1 km WSW of E.B. Eddy Mill, slight TRS odour.
16	Tudhope Street	18-Aug-86 09:48-11:35	0.2 km W of mill, occas. odour, TRS peak at 46 ppb.

*See Figures 1 and 2

TABLE 2

SUMMARY OF ESPANOLA RESULTS

DATE	SITE	TRS (Max. ½hr. ave.)	THC	ALK	CL-ALK
units		ppb	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
Aug. 12	1	9	-		-
	2	21	99	39	15
	3	135	699	229	364
			542	34	427
	1	61	-	-	-
Aug. 13	4	37	880	573	138
			1245	925	86
	5	23	789	490	161
	6	241	1913	51	1575
			1298	22	1098
	3	127	536	69	404
	7	6	132	85	12
	1	91	-	-	-
Aug. 14	8	64	618	122	456
		456	-	-	-
	9	20	235	134	65
	10	61	322	40	255
	11	8	125	33	72
	1	75	-	-	-
Aug. 15	6	157	1702	306	1169
	12	361	205	53	129
	13	26	210	166	0
	1	32	-	-	-
Aug. 16	14	3	-	-	-
	1	54	-	-	-
Aug. 17	1	27	-	-	-
Aug. 18	15	6	-	-	-
	16	11	960	668	114
			523	305	94

Table 3

GC ESPANOLA 86 DATA

	(30 MIN.SAMPLE)	MAXIMUM ug/m^3	MINIMUM ug/m^3	NUMBER of times detected
1	ETHANE			0
2	PROPANE	10.31	1.07	20
3	PROPADIENE			0
4	PROPYNE	0.59	0.59	1
5	CHLOROMETHANE			0
6	CYCLOPROPANE			0
7	2-METHYLPROPANE	118.59	1.05	19
8	CHLOROETHENE			0
9	1-BUTENE	21.40	11.82	3
10	1,3-BUTADIENE			0
11	BUTANE	307.84	2.24	20
12	1-BUTYNE			0
13	CHLOROETHANE			0
14	3-METHYL-1-BUTENE	6.20	1.42	8
15	2-METHYLBUTANE	177.79	2.00	20
16	1-PENTENE	7.19	0.86	12
17	PENTANE	83.04	1.49	20
18	2-METHYL-1,3-BUTADIENE	7.05	1.62	20
19	TRANS-2-PENTENE	17.76	0.91	15
20	CIS-2-PENTENE	6.94	0.68	12
21	DICHLOROMETHANE			0
22	2-METHYL-2-BUTENE	29.17	0.82	18
23	3-CHLOROPROPENE			0
24	2,2-DIMETHYLBUTANE	5.63	0.65	12
25	2-CHLORO-2-METHYLPROPANE			0
26	TRANS-1,2-DICHLOROETHENE			0
27	4-METHYL-1-PENTENE			0
28	3-METHYL-1-PENTENE			0
29	CYCLOPENTANE	10.91	1.14	18
30	2,3-DIMETHYLBUTANE	11.04	0.51	15
31	2-METHYLPENTANE	50.33	1.51	20
32	3-METHYLPENTANE	42.13	0.88	19
33	1-HEXENE	1.67	1.23	4
34	cis-1,2-DICHLOROETHENE			0
35	2-CHLOROBUTANE	2.76	2.36	4
36	HEXANE	50.68	1.47	19
37	TRICHLOROMETHANE	832.96	53.55	14
38	TRANS-3-HEXENE	7.51	1.33	11
39	3-CHLORO-2-METHYLPROPENE			0
40	METHYLCYCLOPENTANE	18.77	0.90	18
41	1,2-DICHLOROETHANE			0
42	1,1,1-TRICHLOROETHANE			0
43	1-CHLOROBUTANE			0
44	BENZENE	12.98	2.01	20
45	TETRACHLOROMETHANE	14.18	6.52	7
46	CYCLOHEXANE	2.05	0.84	7

GC ESPANOLA 86 DATA

	(30 MIN.SAMPLE)	MAXIMUM ug/m^3	MINIMUM ug/m^3	NUMBER of times detected
47	2-METHYLHEXANE	13.45	0.81	18
48	2,3-DIMETHYLPENTANE	5.27	0.96	10
49	CYCLOHEXENE			0
50	3-METHYLHEXANE	14.61	0.60	19
51	DIBROMOMETHANE			0
52	1,2-DICHLOROPROPANE			0
53	2,3-DICHLOROPROPENE			0
54	TRICHLOROETHENE			0
55	1-HEPTENE	2.71	0.77	9
56	2,2,4-TRIMETHYLPENTANE	3.43	0.89	9
57	HEPTANE	9.76	0.81	18
58	1-CHLORO-3-METHYLBUTANE			0
59	TRANS-2-HEPTENE			0
60	METHYLCYCLOHEXANE	5.32	0.76	12
61	2,5-DIMETHYLHEXANE	0.94	0.94	1
62	4-METHYLCYCLOHEXENE			0
63	1-CHLOROPENTANE	1.78	1.54	5
64	1,1,2-TRICHLOROETHANE	5.54	5.54	1
65	TOLUENE	17.09	1.55	20
66	1,3-DICHLOROPROPANE			0
67	2-METHYLHEPTANE	2.84	0.72	10
68	4-METHYLHEPTANE	1.27	0.82	5
69	3-METHYLHEPTANE	4.38	0.96	10
70	1,2-DIBROMOETHANE			0
71	1-OCTENE			0
72	TRANS-4-OCTENE			0
73	2-METHYL-1-HEPTENE			0
74	OCTANE	9.35	0.81	20
75	TRANS12DIMETHYLCYCLOHEXAN	10.27	0.89	20
76	TETRACHLOROETHENE			0
77	2-OCTENE			0
78	PROPYLCYCLOPENTANE			0
79	CIS12DIMETHYLCYCLOHEXANE			0
80	CHLOROBENZENE			0
81	ETHYLCYCLOHEXANE			0
82	1-CHLOROHEXANE			0
83	ETHYLBENZENE	4.94	0.71	9
84	M-XYLENE & P-XYLENE	15.35	1.23	13
85	P-XYLENE (SEE M-XYLENE)			0
86	4-METHYLOCTANE	1.13	0.78	3
87	2-METHYLOCTANE			0
88	3-METHYLOCTANE			0
89	STYRENE			0
90	1,4-DICHLOROBUTANE			0
91	1,1,2,2-TETRACHLOROETHANE			0
92	O-XYLENE	1.52	0.66	6
93	1-NONENE			0

GC ESPANOLA 86 DATA

(30 MIN.SAMPLE)	MAXIMUM ug/m^3	MINIMUM ug/m^3	NUMBER of times detected
94 1,2,3-TRICHLOROPROPANE			0
95 TRANS-1,4-DICL-2-BUTENE			0
96 NONANE	1.75	1.37	2
97 ISOPROPYLBENZENE			0
98 2-CHLOROTOLUENE			0
99 3-CHLOROTOLUENE			0
100 PROPYLBENZENE	1.27	0.81	2
101 4-CHLOROTOLUENE	4.23	2.57	2
102 3-ETHYLTOLUENE	4.40	0.97	8
103 4-ETHYLTOLUENE	4.66	1.40	3
104 1,3,5-TRIMETHYLBENZENE	3.06	0.63	9
105 2-ETHYLTOLUENE	1.60	1.39	2
106 1-DECENE	4.12	1.20	8
107 tert-BUTYLBENZENE	8.16	1.03	14
108 1,2,4-TRIMETHYLBENZENE	8.85	1.12	20
109 1,5-DICHLOROPENTANE	742.51	11.24	18
110 1,3-DICHLOROBENZENE	5.59	2.88	2
111 TERTBUTYLCYCLOHEXANE			0
112 (CHLOROMETHYL)BENZENE			0
113 DECANE	2.61	2.07	4
114 ISOBUTYLBENZENE			0
115 3-(CHLOROMETHYL)HEPTANE			0
116 SEC-BUTYLBENZENE			0
117 1,2,3-TRIMETHYLBENZENE	3.62	1.76	3
118 1ISOPROPYL4METHYLBENZENE	244.03	3.22	12
119 1,2-DICHLOROBENZENE			0
120 INDAN	1.77	1.02	5
121 BUTYLCYCLOHEXANE			0
122 1,3-DIETHYLBENZENE			0
123 1,4-DIETHYLBENZENE	3.36	1.56	5
124 BUTYLBENZENE	2.11	0.98	9
125 1,2-DIETHYLBENZENE			0
126 T-DECALIN			0
127 UNDECANE	8.99	2.11	13
128 DECAHYDRONAPHTHALENE			0
129 C-DECALIN			0
130 1235-TETRAMETHYLBENZENE	4.79	2.59	6
131 1234-TETRAMETHYLBENZENE			0
132 1234-TETRAHYDRONAPTHALENE			0
133 1,4-DIISOPROPYLBENZENE			0
134 DODECANE	8.80	2.23	14
Total Compounds Identified	53.00	23.00	20
Total # of Peaks	97.00	38.00	20
Total Area of Peaks	42195.09	5767.47	20
Area of Identified Peaks	37829.61	3289.55	20

GC ESPANOLA 86 DATA

	MAXIMUM	MINIMUM	NUMBER
(30 MIN.SAMPLE)			
Area % Identified Peaks	89.65	47.80	20
Total Hydrocarbons ug/m3	1913.35	99.18	20
Alkanes ug/m3	925.13	22.10	20
Cycloalkanes ug/m3	42.61	1.98	20
Alkenes ug/m3	98.92	2.81	20
Cycloalkenes ug/m3	0.00	0.00	20
Alkynes ug/m3	0.59	0.00	20
Aromatics ug/m3	262.33	10.82	20
Chlorinated Alkanes ug/m3	1575.47	0.00	20
Chlorinated Alkenes ug/m3	0.00	0.00	20
Chlorinated Aromatics ug/m3	9.82	0.00	20
			0
Benzene:Ethylbenzene			20
Toluene:Ethylbenzene			20
Xylenes:Ethylbenzene			20